

1 TITLE OF THE INVENTION

2 **Wireless Communication Terminal for Sending Messages for Reporting
3 Power Turn-off Events**

4 BACKGROUND OF THE INVENTION

5 Field of the Invention

6 The present invention relates generally to wireless communication
7 networks, and more specifically to a power monitoring and reporting
8 technique for a fixed wireless communication network where wireless user
9 terminals are normally energized with an external power source such as the
10 mains (commercial) power supply and energized with an internal battery
11 when the external power fails.

12 Description of the Related Art

13 Wireless communication systems such as FWA (fixed wireless access)
14 have been developed as a means for establishing broadband user access
15 channels between subscriber terminals and a communication network with
16 an initial cost lower than the cost of laying wires and cables. The subscriber
17 terminal is located in the user's premises and is energized by an external
18 power source such as the mains supply. An internal battery is provided as a
19 backup power source to be used when the external power source fails. If the
20 battery voltage falls below some critical value, the battery power is turned off
21 to prevent it from being excessively discharged. The failure in the external
22 power source may be caused by power outage of the mains supply or by an
23 inadvertent disconnection of the power line cord from the power outlet to the
24 user terminal. When the user terminal is not working, the user is likely to
25 place a complaint call to the network about the malfunctioning of his

1 terminal, requesting a maintenance personnel to be dispatched to the user's
2 premises for repairing the trouble. Since the network has no way of knowing
3 the cause of the trouble, it has been necessary to make a trip to the premises
4 of the complaining user.

5 Therefore, there exists a need to allow the maintenance personnel to
6 identify the cause of a trouble in order to make it unnecessary for making a
7 trip to the user terminal if the power source is identified as a probable cause
8 of the trouble.

9 SUMMARY OF THE INVENTION

10 It is therefore an object of the present invention is to eliminate the need
11 for a network maintenance personnel to make a trip to the site of a trouble
12 for a possible cause of external power source.

13 According to a first aspect of the present invention, there is provided a
14 wireless communication terminal comprising wireless communication
15 circuitry for establishing a wireless communication channel to a network, an
16 internal power source and an external power source, control circuitry for
17 energizing the wireless communication terminal with the external power
18 source and energizing the wireless communication terminal with the internal
19 power source when the external power source is faulty, and monitor circuitry
20 for monitoring the external power source and sending a message from the
21 wireless communication circuitry to the network when the communication
22 terminal is operating with the internal power source.

23 According to a second aspect, the present invention provides a
24 wireless communication network comprising a base station, a base station
25 controller connected to the base station, and a wireless communication
26 terminal. The wireless communication terminal comprises wireless

1 communication circuitry for interfacing the wireless communication terminal
2 to the base station, an internal power source and an external power source,
3 control circuitry for energizing the wireless communication terminal with the
4 external power source and energizing the wireless communication terminal
5 with the internal power source when the external power source is faulty, and
6 monitor circuitry for monitoring the external power source and sending a
7 message from the wireless communication circuitry to the base station
8 controller via the base station when the communication terminal is operating
9 with the internal power source.

10 According to a third aspect, the present invention provides a method
11 of controlling a wireless communication terminal, wherein the terminal
12 comprises wireless communication circuitry for interfacing the wireless
13 communication terminal to a network, an internal power source and an
14 external power source. The method comprises the steps of energizing the
15 wireless communication terminal with the external power source and
16 energizing the wireless communication terminal with the internal power
17 source when the external power source is faulty, monitoring the external
18 power source, and sending a message from the wireless communication
19 circuitry to the network when the communication terminal is operating with
20 the internal power source.

21 BRIEF DESCRIPTION OF THE DRAWINGS

22 The present invention will be described in detail further with reference
23 to the following drawings, in which:

24 Fig. 1 is a block diagram of a fixed wireless access (FWA)
25 communications network of the present invention;

26 Fig. 2 is a block diagram of an FWA user terminal;

27 Fig. 3 shows the data structure of a location registration message sent

1 from the user terminal; and

2 Fig. 4 is a flowchart of the operation of the network according to the
3 present invention.

4 DETAILED DESCRIPTION

5 Referring to Fig. 1, there is shown a fixed wireless access (FWA)
6 communications network according to the present invention.

7 As illustrated, the network is comprised of a base station controller 1
8 which is connected via a communication link 3 to a plurality of wireless base
9 stations. Base station controller 1 may be co-located with a switching system
10 within the same switching office building or located in a maintenance center.
11 For purposes of disclosure, only one wireless base station 2 is illustrated for
12 individually serving user terminals 4 via fixed wireless access channels 5. A
13 maintenance terminal 6 and a memory device 7 are connected to the base
14 station controller 1. Data received from the user terminals 4 are stored in the
15 memory device 7. Maintenance terminal 6 is attended to by the maintenance
16 personnel of the network, who analyzes the data stored in the memory device
17 7.

18 As shown in Fig. 2, each user terminal 4 includes a communication
19 processor 10 connected to a user interface 11 and an air interface 12. Air
20 interface 12 establishes a CDMA (Code Division Multiple Access) channel to
21 the base station 2 according to the ANSI/(American National Standard
22 Institute)/TIA (Telecommunications Industry Association)/EIA (Electronic
23 Industries Alliance)-95B. As a primary power voltage, an external power
24 source 14 such as the commercial a.c. power is connected to the power control
25 unit 13, which rectifies the a.c. voltage and supplies a constant d.c. voltage to

1 the communication processor 10 and the air interface 11. An internal
2 rechargeable battery 15 is also connected to the power control unit 13 as a
3 backup power source when the external power should fail. When the
4 external power source is normal, the rechargeable battery 15 may be trickle-
5 charged by the power control unit 13. The user terminal normally operates
6 on the external power source 14. If the external power should fail, the user
7 terminal is switched to the internal battery 15 for continued operation. A
8 monitor circuit 16 is provided to monitor the communication processor 10
9 and the power control unit 13 and sends a report message to the base station
10 controller 1 via the base station 2 as to a state of the varying power condition
11 of the user terminal. The report message received by the base station
12 controller is stored in the memory device 7 and a collection of such messages
13 are analyzed by the maintenance terminal 6.

14 For centralized management of report messages, it is advantageous to
15 use the format of the ANSI/TIA/EIA-95B location registration message
16 which is defined as an interface between the FWA subscribers and the
17 serving base station. As shown in Fig. 3, the ANSI/TIA/EIA-95B location
18 registration message has a number of fields for setting an 8-bit message
19 length, an 8-bit message type, and an 8-bit message field which is divided
20 into a 4-bit registration type sub-field and a 4-bit reserve sub-field. The
21 message is terminated by a 30-bit cyclic redundant check field. In the present
22 invention, the four-bit registration type sub-field is used to transmit report
23 messages.

24 The operation of the monitor circuit 16 of each user terminal proceeds
25 according to a flowchart shown in Fig. 4.

1 Initially, the monitor circuit 16 checks the power control circuit 13 to
2 see if the user terminal is supplied with the external power (step 101). If this
3 is the case, the monitor circuit 16 proceeds to step 102 to formulate a report
4 message and transmits it from the processor 10 to the base station controller
5 to indicate that the user terminal is normally operating with external power.
6 The registration type sub-field of this normal report message contains "0001".

7 Monitor circuit 16 proceeds to decision step 103 to check the
8 communication processor 10 and determines if a call is in progress. If the
9 user terminal is not in communication with the base station, then the monitor
10 circuit checks the external power source to see if it has failed or not (step 104).
11 If the external power source is normal, steps 103 and 104 are repeated. If the
12 external power source has failed, the decision at step 104 is affirmative and
13 the monitor circuit 16 proceeds to step 105 to direct the power control unit 13
14 to switch over the user terminal to the internal battery 15.

15 Then, the monitor circuit 16 monitors the battery voltage to determine
16 whether it is higher than a critical lower limit. If the battery voltage falls
17 below the critical level, the decision at step 106 is negative and the monitor
18 circuit 106 proceeds to step 107 to formulate a report message with the
19 registration type sub-field set with "1100" bits and transmits it to the base
20 station controller, indicating that the external power source of a user terminal
21 becomes faulty when no call is in progress and its battery voltage has
22 dropped below the critical level. Monitor circuit 16 proceeds to step 108 to
23 direct the power control unit 13 to turn off the battery to prevent it from
24 being excessively discharged, and returns to the starting point of the routine
25 to check for possible recovery of the external power source.

1 If the battery voltage is higher than the critical lower limit, the decision
2 at step 106 is affirmative and flow proceeds to step 109 to check to see if the
3 external power source is recovered. If not, steps 107 and 109 are repeated. If
4 the external power source is recovered, the monitor circuit exits step 109 and
5 returns to step 102 to send a report message indicating that the external
6 power has been recovered.

7 If the external power source is normal and the user terminal is in
8 communication with the base station, the decision at step 103 is affirmative.
9 In such instances, the monitor circuit proceeds from step 103 to step 112 to
10 check to see if the external power source has failed. If this is the case, flow
11 proceeds to step 113 to switch over the user terminal to the internal battery
12 power and the status of the call is monitored (step 114). If the call has
13 terminated, flow proceeds from step 114 to step 106. If the call is still in
14 progress, the monitor circuit proceeds to step 115 to check to see if the battery
15 voltage is higher than the lower limit.

16 If the battery voltage is higher than the lower limit, steps 114 and 115
17 are repeated. If the battery voltage falls below the critical level, the monitor
18 circuit proceeds from step 115 to step 116 to direct the communication
19 processor 10 to forcibly terminate the call and proceeds to step 117 to
20 formulate a report message by setting its registration type sub-field with
21 "1101" bits and transmit the message to the base station controller, indicating
22 that the external power source of a user terminal becomes faulty during a call
23 and the battery voltage has dropped below the critical level. Flow proceeds
24 from step 117 to step 108 to formulate a report message by setting the
25 registration type sub-field with "0011" bits (which indicates that the battery

1 power is being turned off) and transmit the message to the base station
2 controller and turn off the battery power. Flow returns to step 101.

3 Since report messages sent from the user terminals are stored in the
4 memory device 7 at the base station controller, the maintenance personnel
5 can identify the source of a trouble if a complaint call is received from a user.
6 If such a report message has been received from a complaining user, the
7 maintenance personnel is able to instruct the user to fix the trouble. In this
8 way, the need to identify the trouble by making a trip to the user's premises
9 can be eliminated.

10 In addition, the present invention allows maintenance personnel to
11 distinguish between the power turn-off event that occurs when no call is in
12 progress and the power turn-off event that occurs when a call is in progress.
13 If the former occurs, the disconnection of the power line cord is likely the
14 primary cause of the trouble and the internal battery may also be deteriorated
15 due to frequent turn-off of the external power source. If the latter occurs
16 frequently, it is likely that the power line cord is the cause of the trouble.